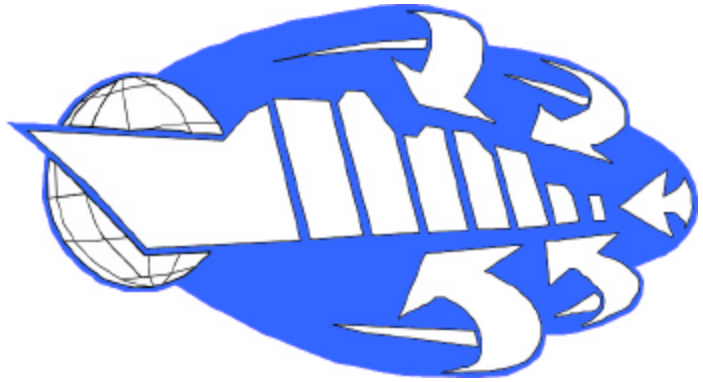
Total Ship Open System Architecture

Translating Open Systems Architecture Into Ship Acquisition Programs

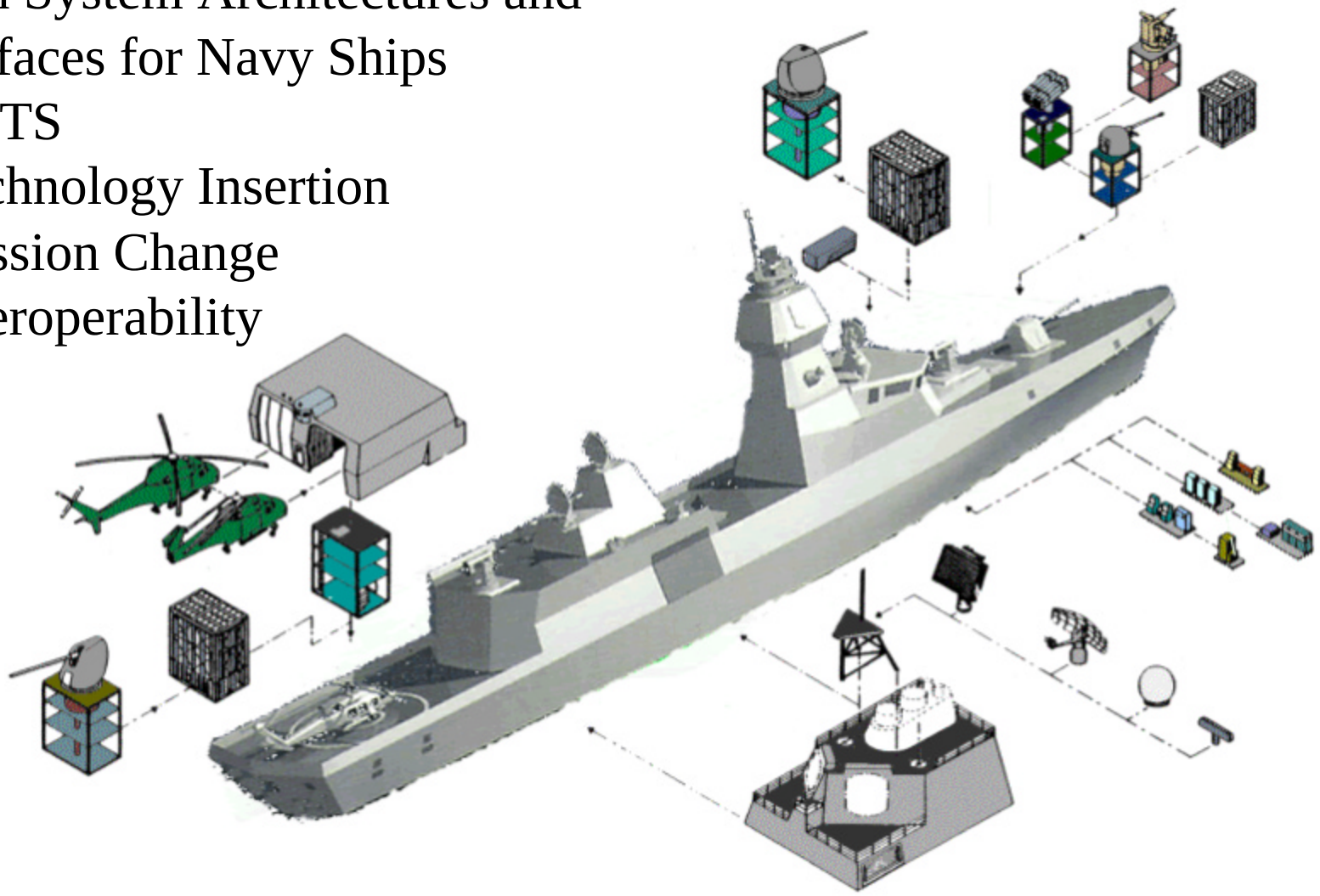


Mr. Jack Abbott
TOSA Team Leader
24 October 2002

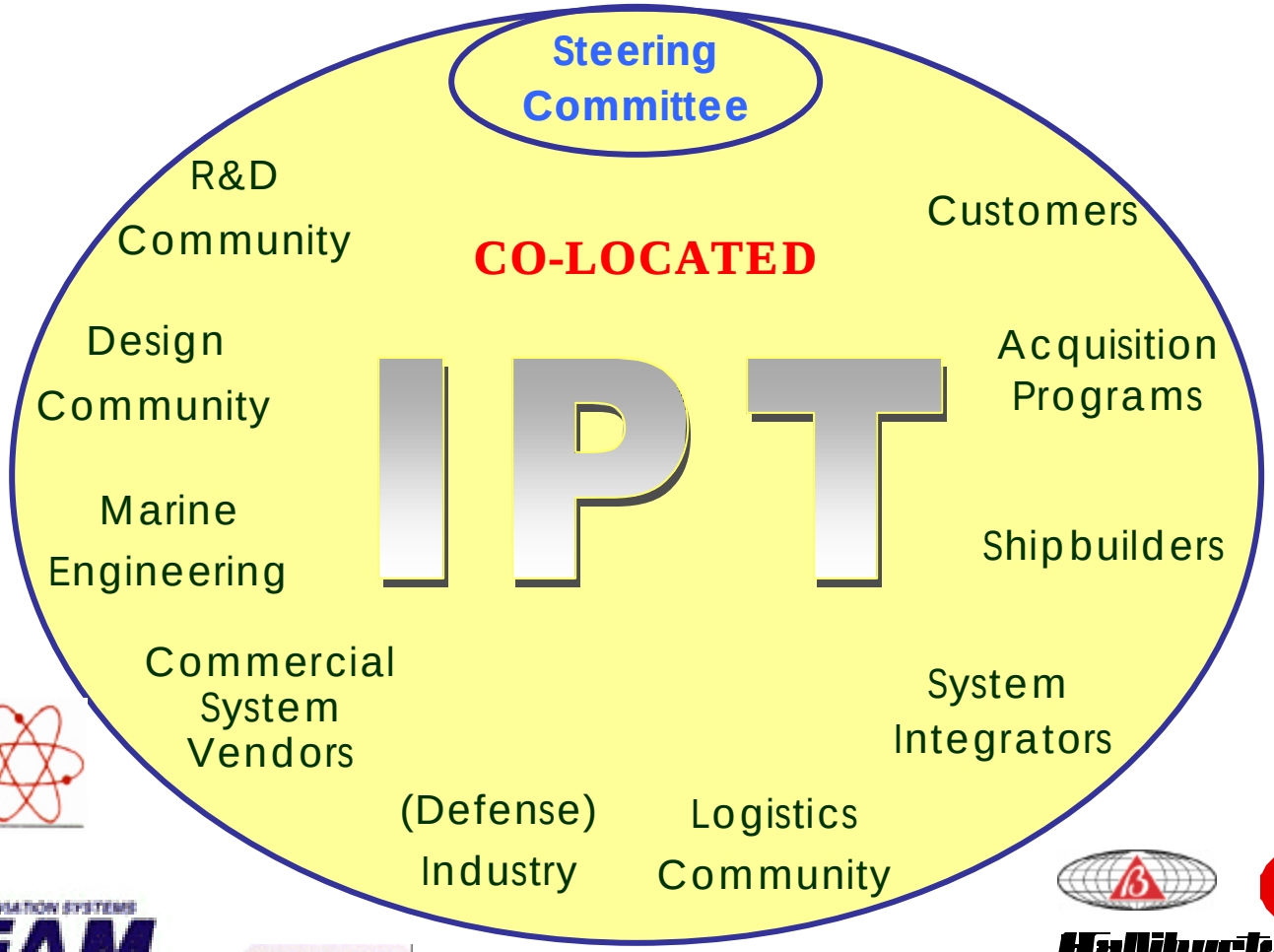
Total ship Open System Architecture (TOSA)

Open System Architectures and Interfaces for Navy Ships

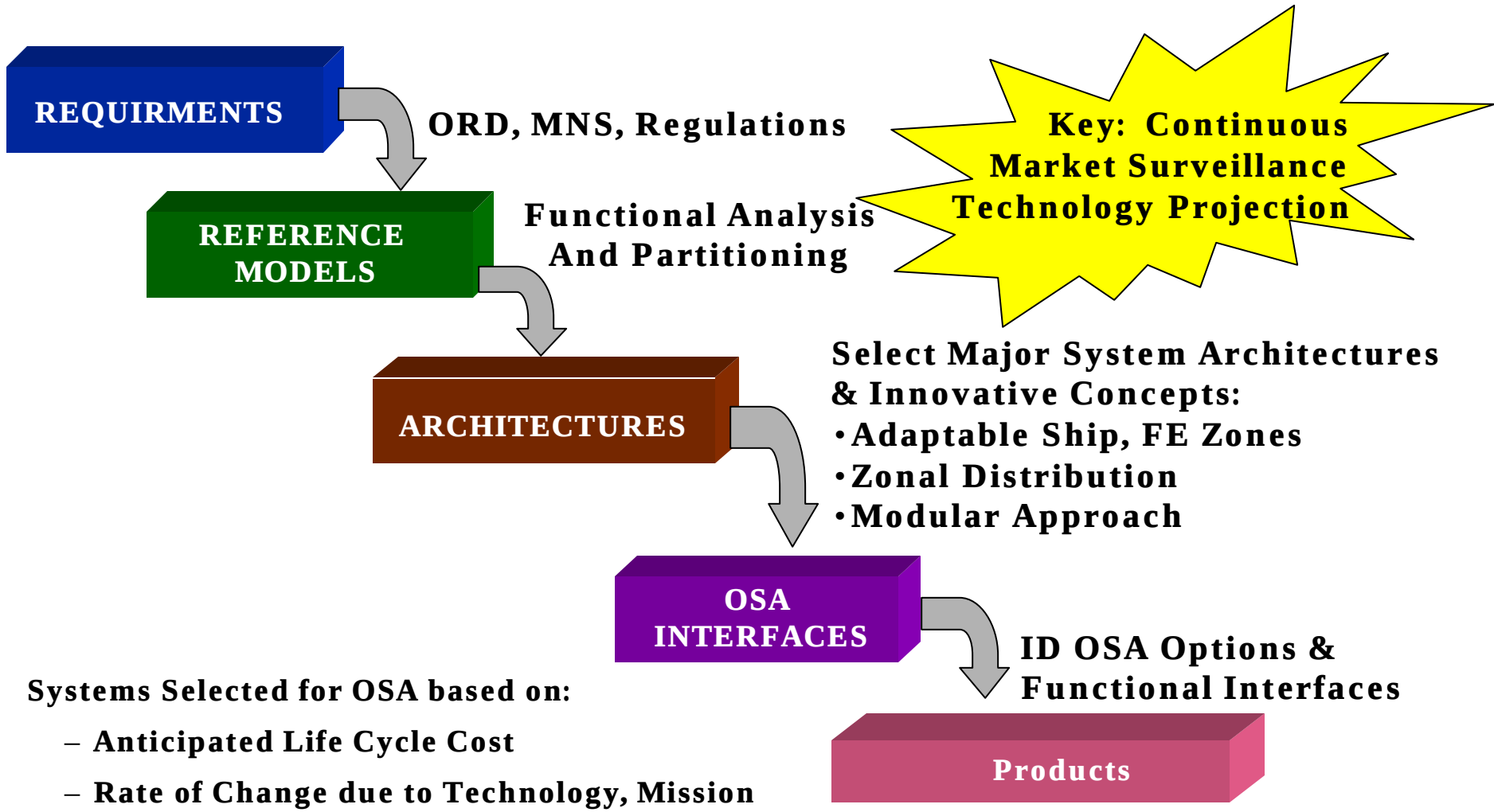
- COTS
- Technology Insertion
- Mission Change
- Interoperability



TOSA Industry-Navy Integrated Product Team



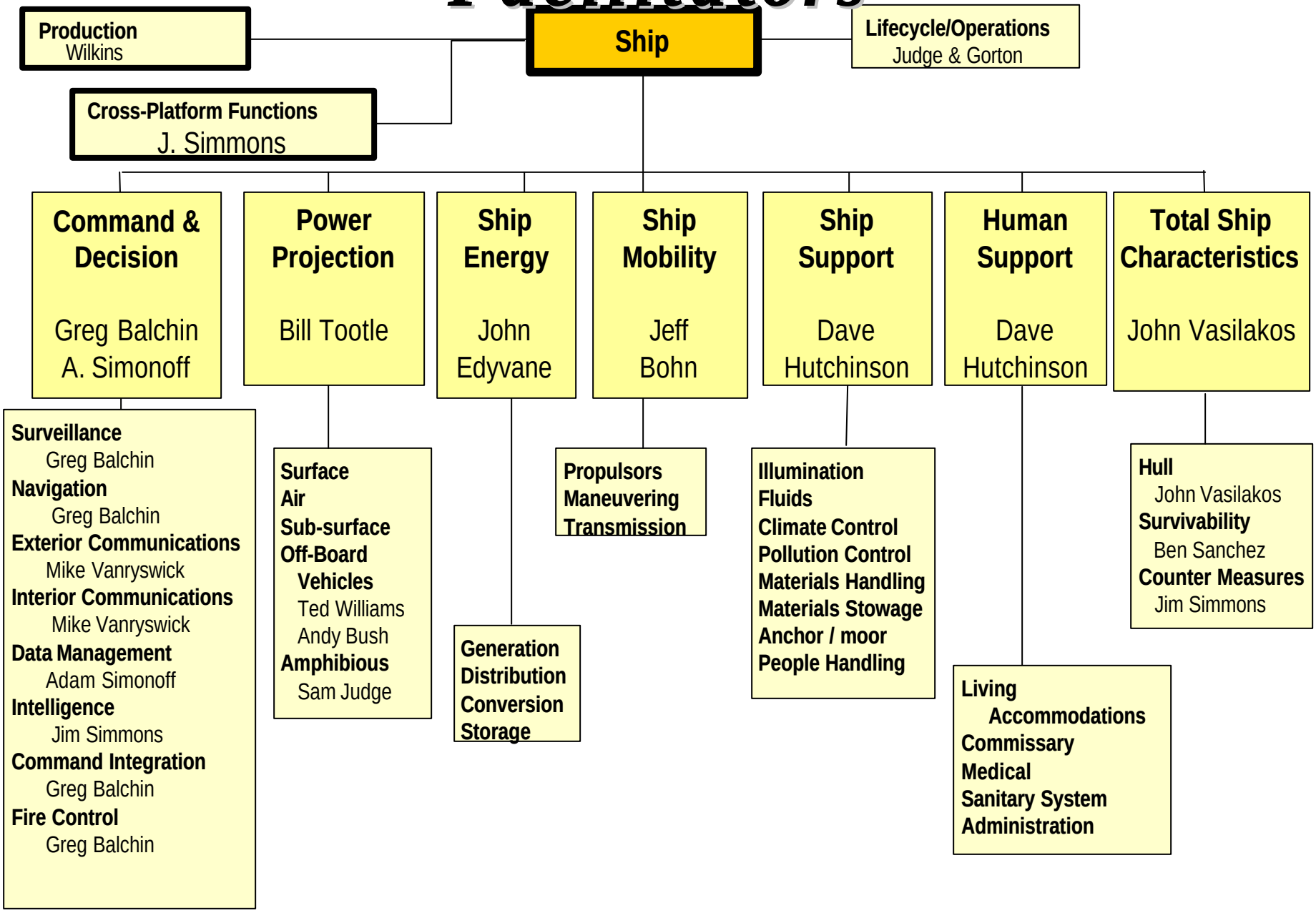
TOSA Process Developed



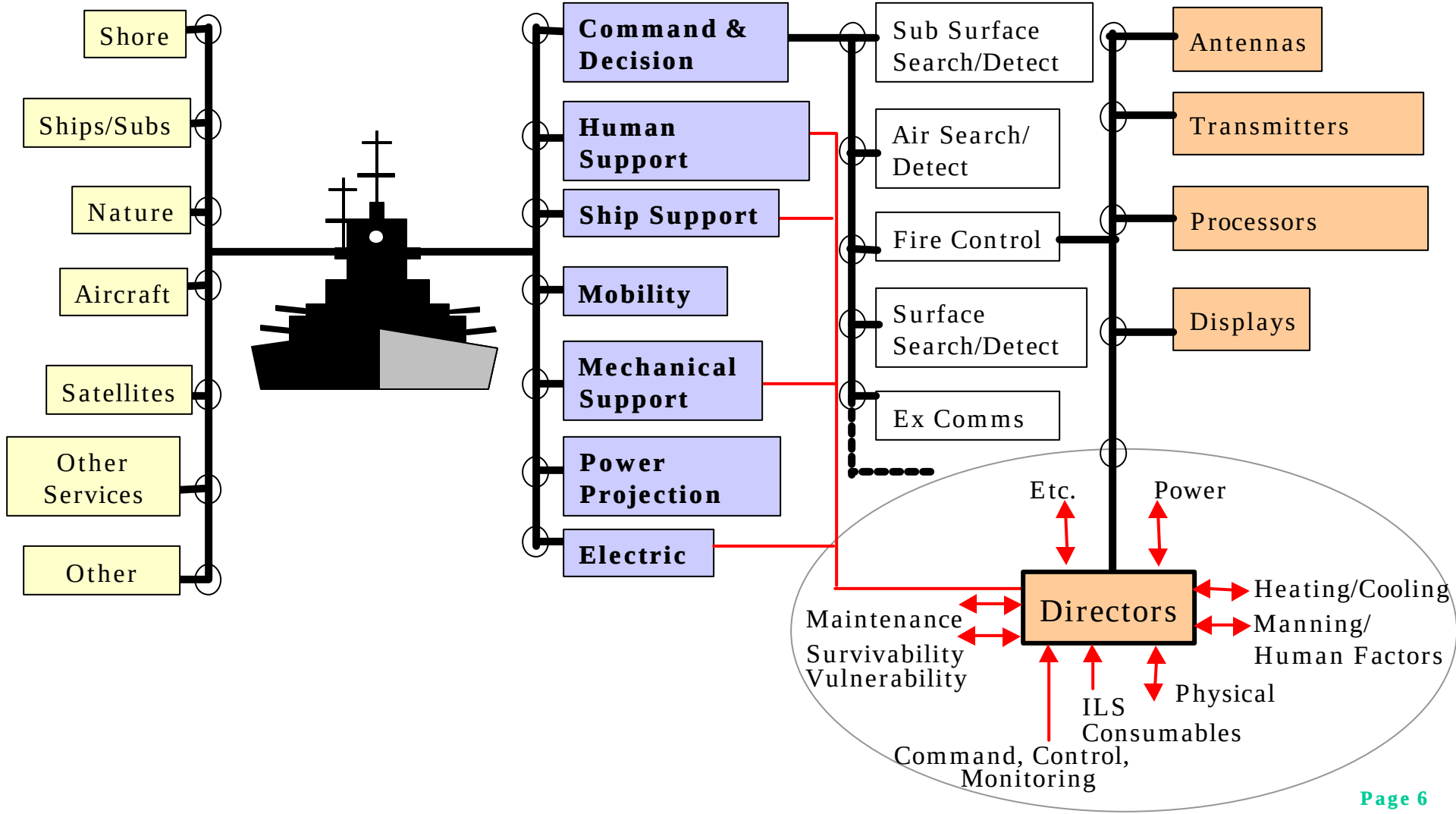
Systems Selected for OSA based on:

- Anticipated Life Cycle Cost
- Rate of Change due to Technology, Mission Needs, Regulations or Maintenance
- Availability of Commercial Technology

Functions and Technology Facilitators



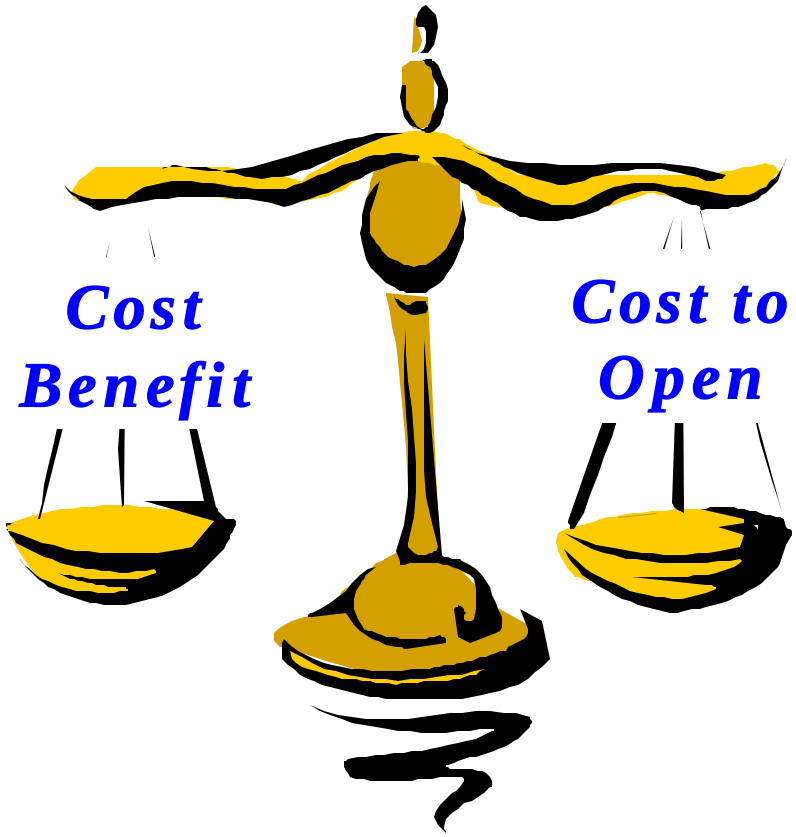
Interfaces at Multiple Architectural Levels



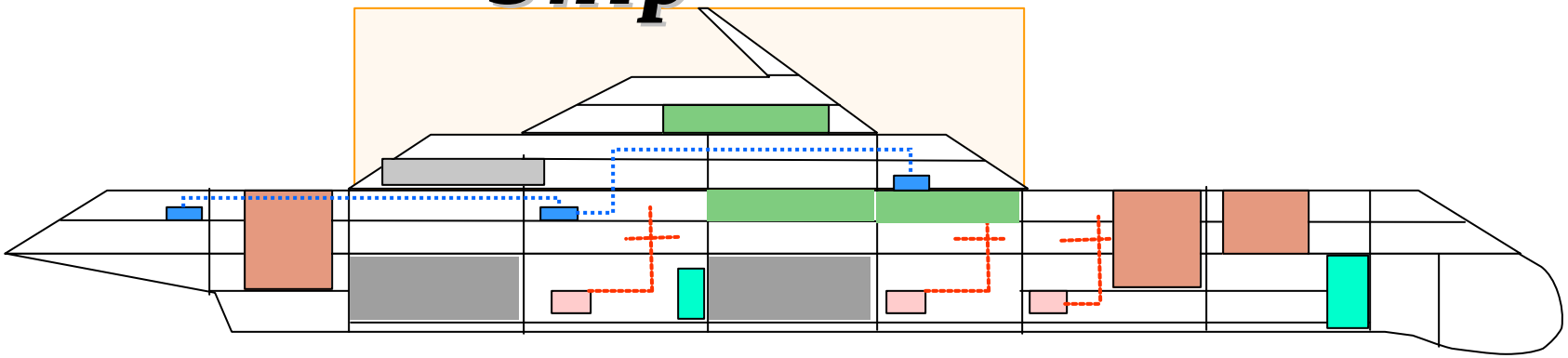
Selection Criteria

Forces of Change:

- Operational Architecture
  - Mission Needs
  - Threat
- Technology
- Market
  - Availability (Tech. Obsolescence)
- Cost
- Regulations
- Logistics
  - Maintenance
  - Failure
  - PMS



The Adaptable Ship



Open Zones

- Ordnance
- Machinery Equipment
- **C4I**
- Off board Vehicles (OV)
- Topside
- Other

Open Systems

Various

Open Distributed Systems

IPS

HVAC

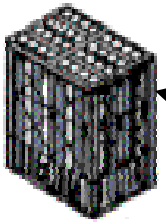
TSCE

Etc.

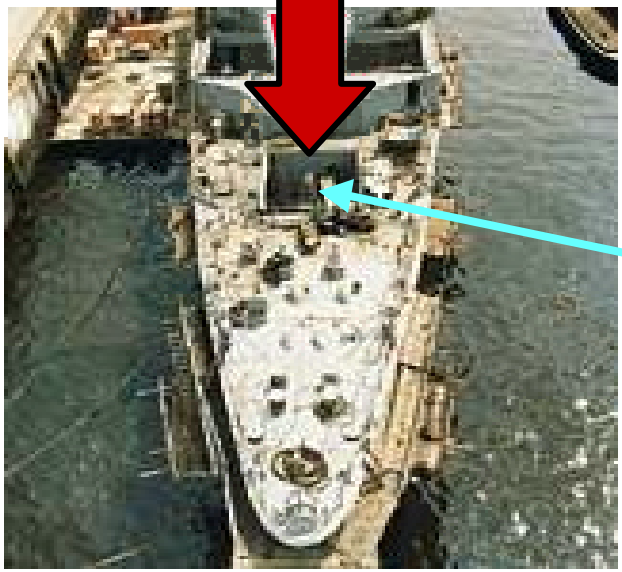
Open Modules

Various

Modular Architectures, Common Interfaces



Mission Modules
- **Both Physical**
- **And Virtual**



Mission Module Station

INTERFACES:

- Physical (Geometric & Tolerances), Piping connections
- Weight and CG / VCG
- Services: Electrical, Air,Cooling
- Monitoring & Control Sensors
- Human Factors
- Survivability/Vulnerability: shock/vibration/EMI/EMC
- Data & information

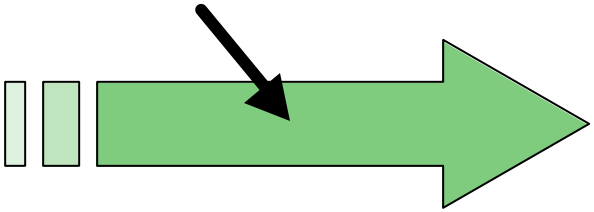
Spiral Development/ Evolutionary Acquisition

- Develops an initial system design based on mature technologies
- The first increment is militarily useful but 60% to 80% of the desired final capability
- Followed by subsequent increments of increased capability
- Uses an iterative process within each increment with interaction between the user, tester, and developer:
- Engineering for evolutionary acquisition and spiral development is the maximum use of modular open systems that allow for affordable and timely integration of new technologies into the current design, both forward fit and retrofit.

First Increment

60% to 80% of the Desired Final Capability

Technology Insertion

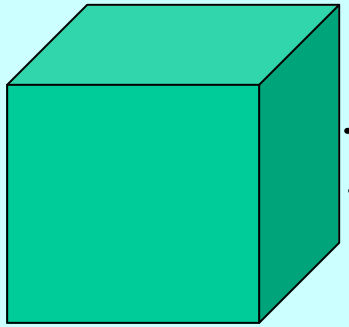


Final Increment

Full Capability

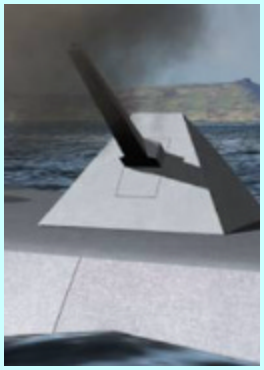
Transformation, Spiral Development and Technology Management

Example

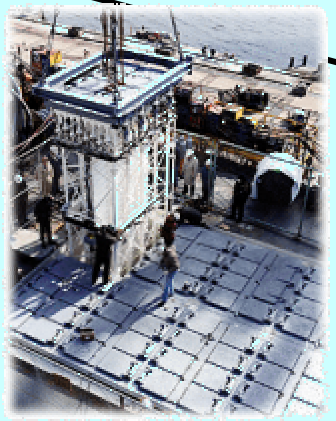


Architecture and Interfaces to accommodate multiple technologies/systems

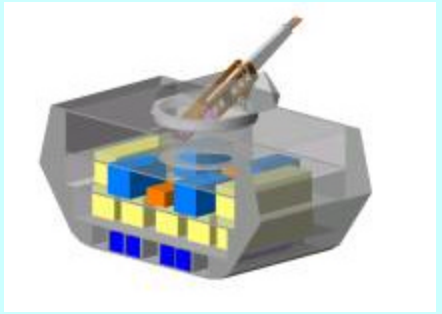
Mk 45



AGS



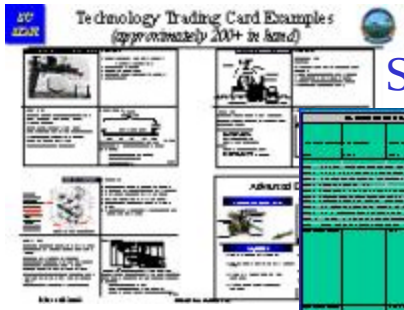
VLS



Rail Gun

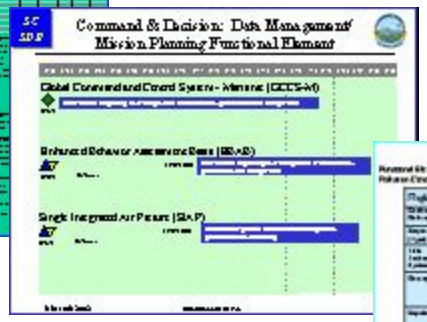
Technology Management Process

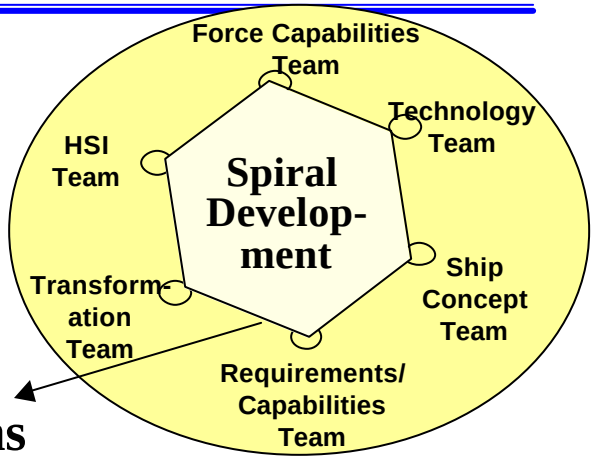
Charts ← **Technology Opportunities** →



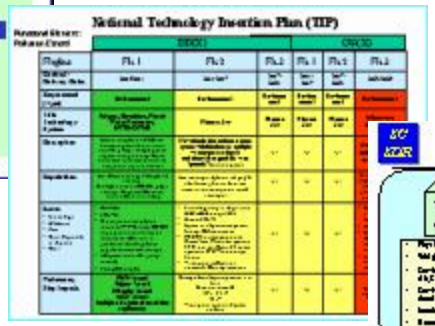
Spreadsheets

Timelines

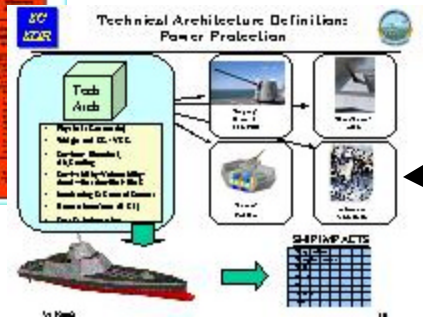




Technology Insertion Plans



Technical Architecture

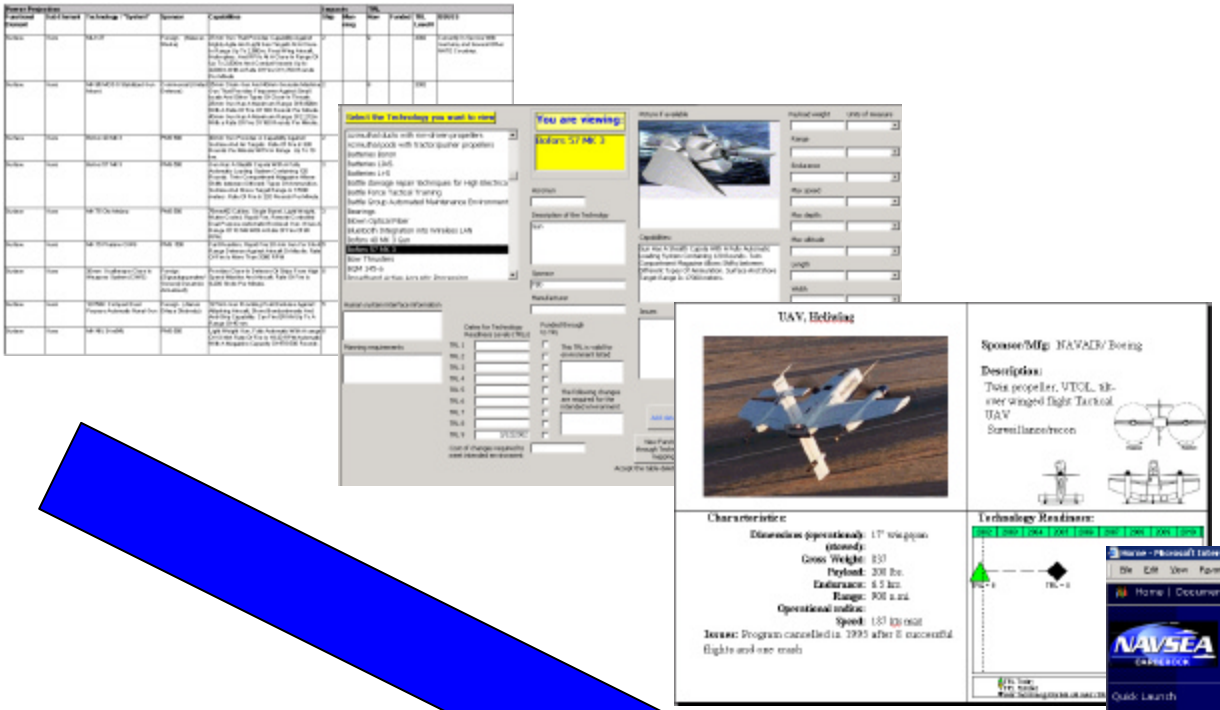


Team with Industry

Database for Opportunities Management

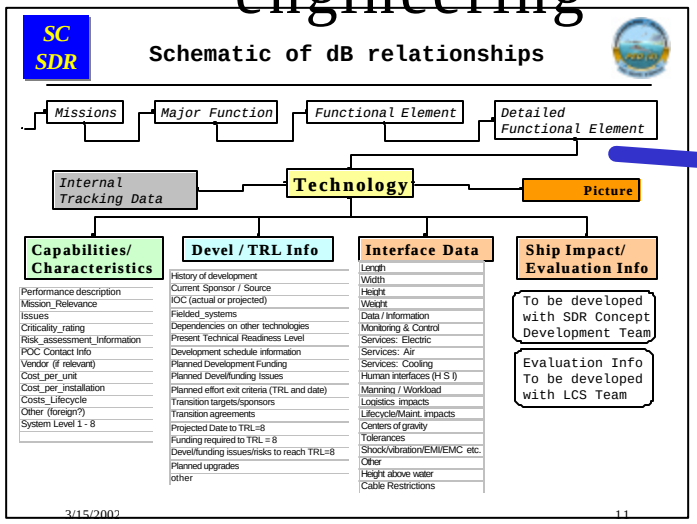
Tech Management Process

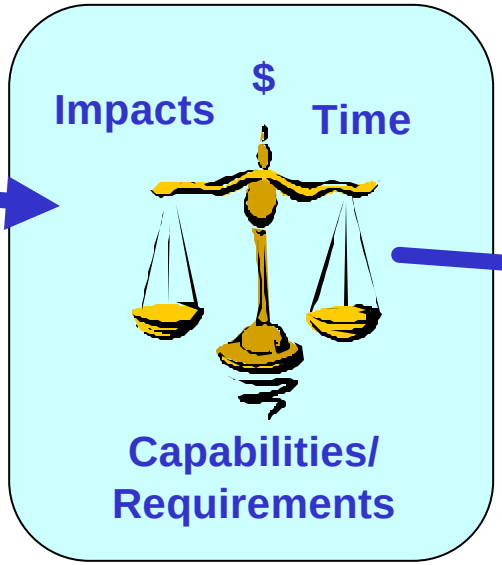
Technology Management Database System (TMDS)

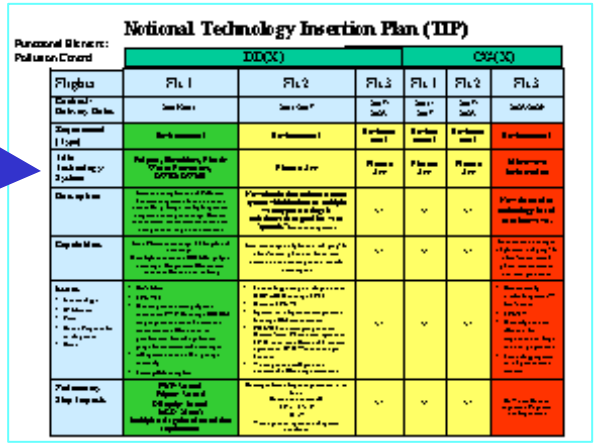


Family of Ships SDR Technology Insertion Plans

- Use of TMDS for equipment suite tradeoffs
- Initiated interactions with other SDR teams
- Developed example TIPs
- Support program managers as part of systems engineering



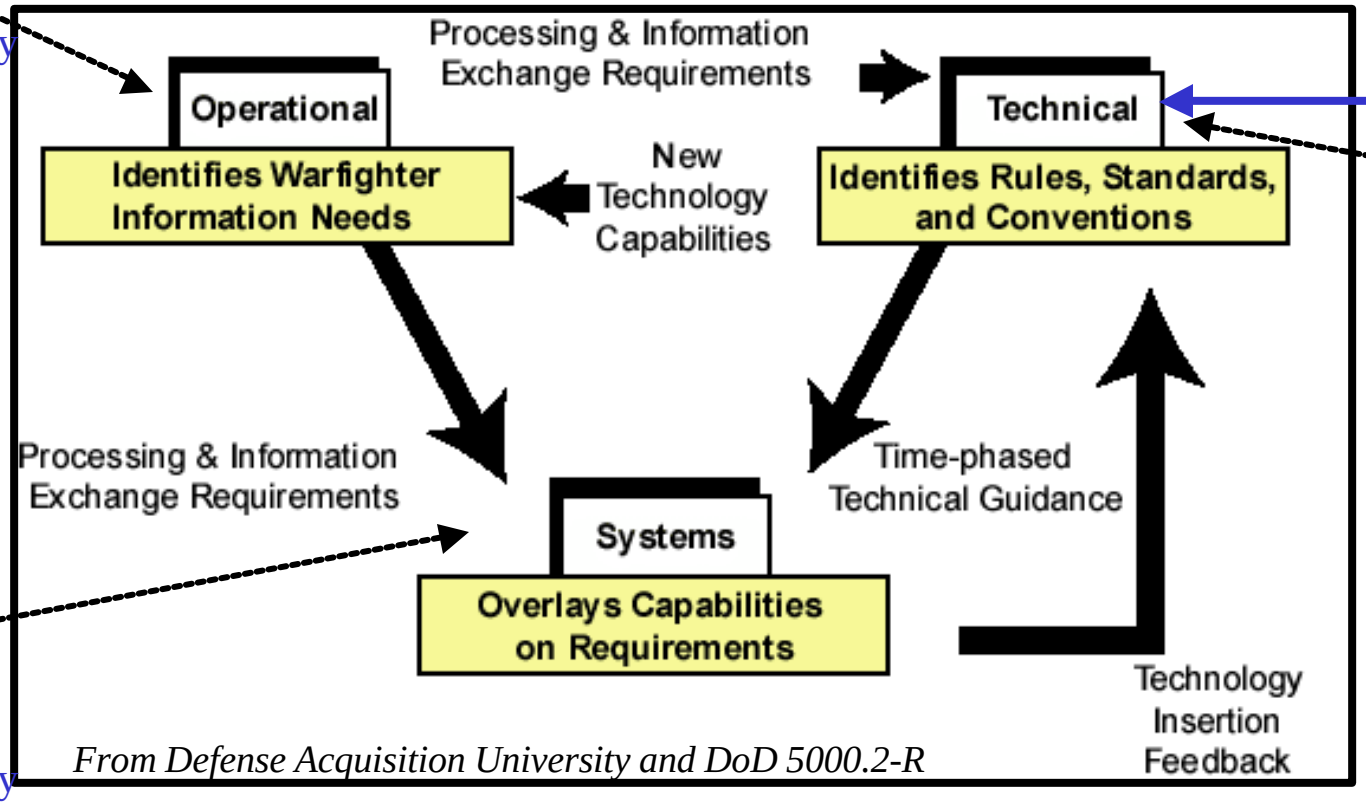




Role of Technical Architecture in Ship Acquisition

Technical Architecture: Architecture and Interfaces

Navy
Primary
Responsibility



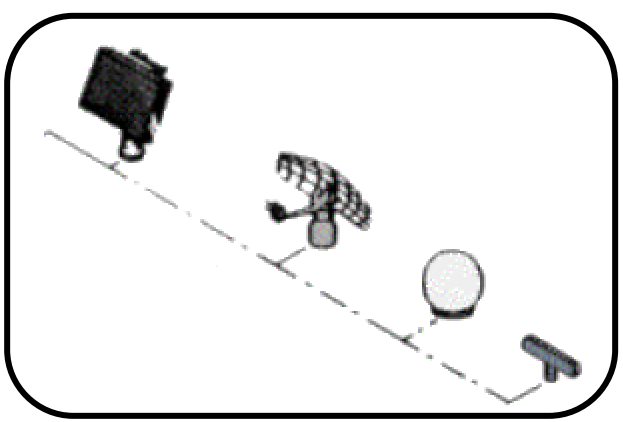
From Defense Acquisition University and DoD 5000.2-R

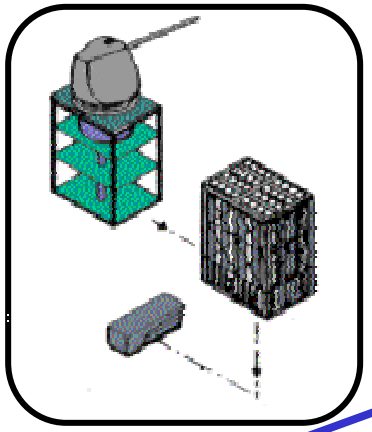
Navy &
Industry
Combined
Responsibility

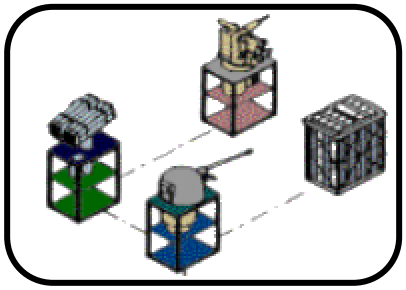
Industry
Primary
Responsibility

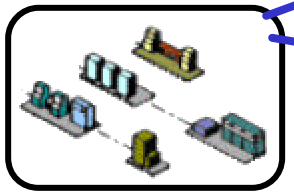
Acquisition = Performance Specs + Technical Architecture

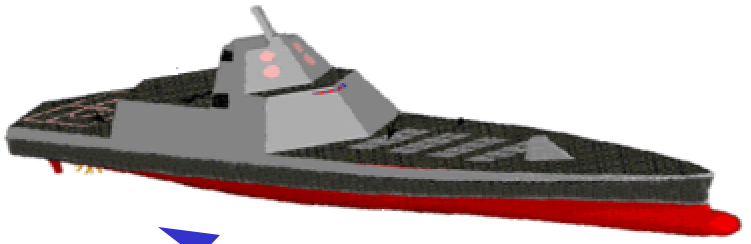
Example Family of Ships Technical Architecture



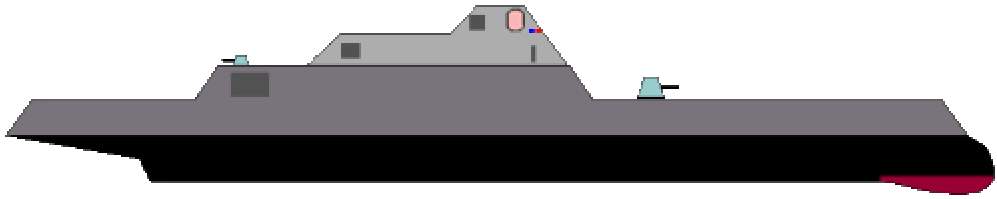








NOTIONAL DD(X)



NOTIONAL CG(X)

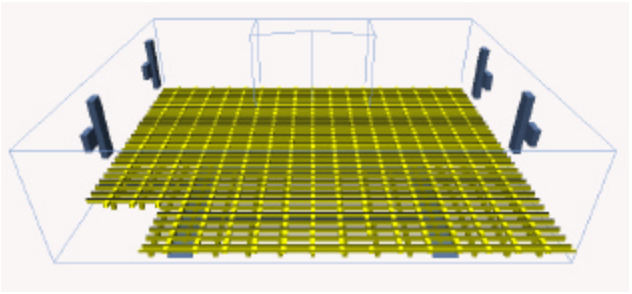
Future Ships (i.e. LCS)

- **Accommodate initial budget constraints**
- **Enables Transformation**
- **Mitigate risks**

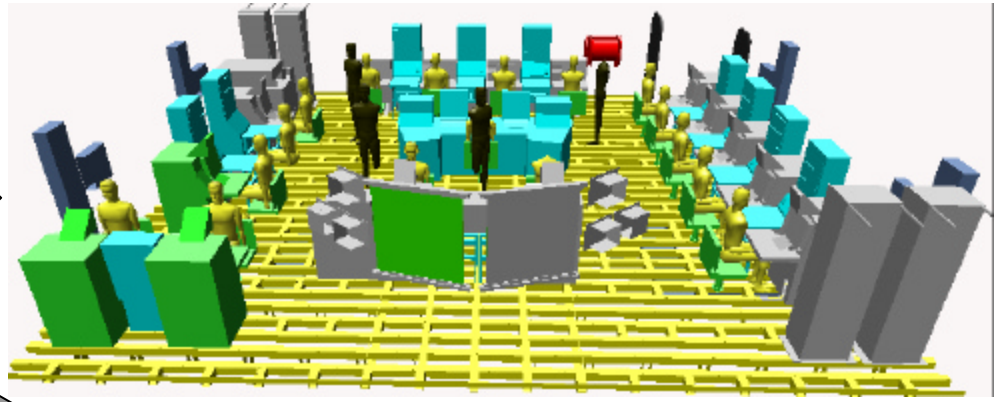
TOSA Focus Areas

- Combat Systems
  - **C4ISR Zone ***
  - **Communications**
  - **OOV's ***
  - **PARS ***
  - **Power Projection***
  - **Surveillance/FC**
- HM&E Systems
  - **Ship Energy &Mobility**
  - **Ship Human Support**
  - **Ship Transfer Systems**
  - **SMMOA**
    - ★ **OSNI ***
    - ★ **OMCI ***
    - ★ **OLSI**

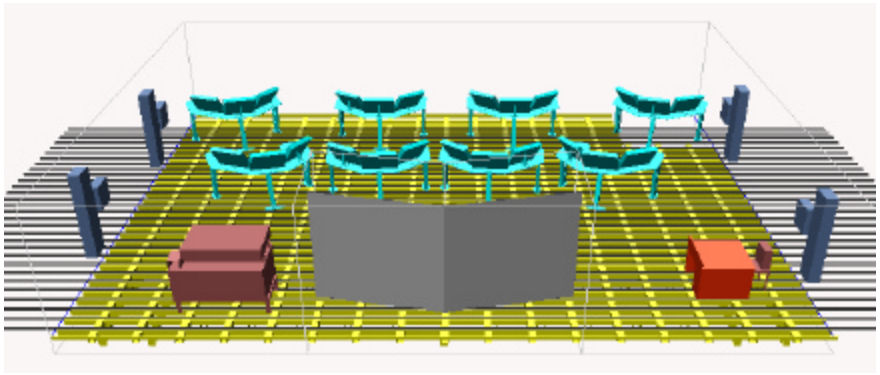
Open Command and Control Zone



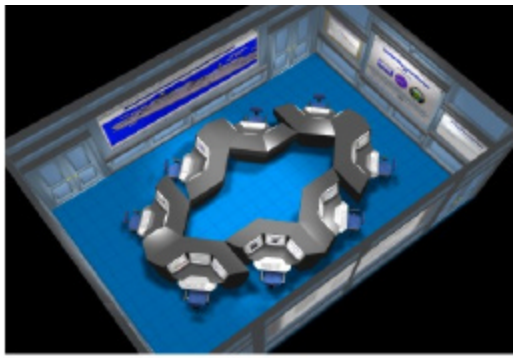
Notional C4I Template



16 person CIC **c. 2005**



8 person CIC
c. 2015



Integrated Command Environment Concept (ICE)
c. 2035

Open C4ISR Zone Industry/Navy Consortia Established

Consortia Members

General Dynamics - Bath Iron Works
Northrop Grumman - Ingalls Shipbuilding Division
Northrop Grumman - Avondale Shipbuilding Industries
U. S. Navy (TOSA Team/PSNS Boston Det./NAWCAD)
Northrop Grumman - Newport News Shipbuilding (Fall 02)

Standard Architecture and Interfaces

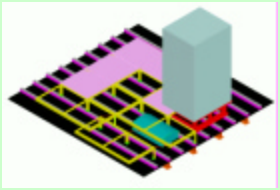
Console / Workstation / Cabinet

Interfaces

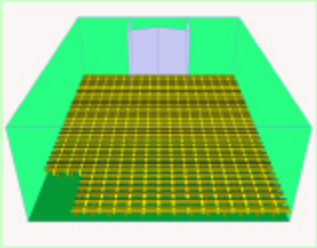
Ship

FOUNDATION

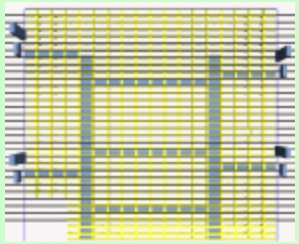
ISO 7166



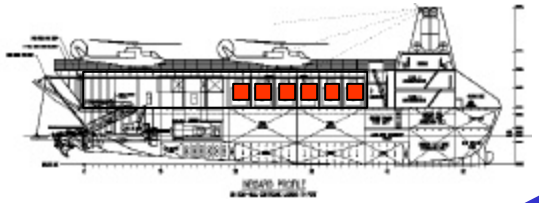
HVAC



POWER, LIGHTING & DATA



Offboard Organic Vehicles (OOV's)



Common Technical Architecture & Std Interfaces

X Craft

- Office of Naval Research's test ship, intended to:
  - Test high speed hull and lifting body characteristics
  - Test a variety of mission systems/technologies
- Currently in design phase
- IOC FY04
- Catamaran
- Aluminum Hull and Superstructure
- Displacement <1000 Tons

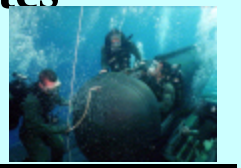
Near-Term Test Candidates

RMS

Firescout VT-UAV

RHIB/ Spartan

OWL



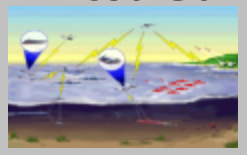
Seal Delivery Vehicle

"Next Generation" Test Candidates

ASH

Dragon Warrior

DragonFly/ Swarm

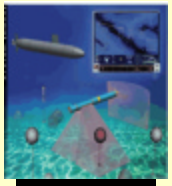


SPARTAN

RMS

Future Test Candidates

Hummingbird



LMRS

Gladiator

OOV Modularization and Module Zonal Distribution

Example: 11 Meter Rigid Hull Inflatable Boat

Launch and Recovery Zone

Launch and Recovery Module

Fueled Vehicles Storage Zone

RHIB Module

Control Zone

Control Station Module

Fuel Storage Zone

Fuel Module

Mission Bay Zone

ISO 20' x 8' x8' Container

Mission modules.

ISO 20' x 8' x8' Module Containers are only intended for the X Craft application

Spare parts Module

Utility OSA Interface

Precision Approach Radar Systems (PARS)

PMA 213's problem:

Decreasing ship availability lengths and installation / procurement funds.

TOSA's goals:

- **Re-engineer the equipment installation process of a candidate PAR system and reduce installation time from 90 days to 60 days onboard a CVN, LHA, or LHD class ship.**
- **Develop equipment**

SPN-35

SPN-41

SPN-46

Supply, Maintenance, and Monitoring Open Architecture (SMMOA)

- TOSA has established the following elements as part of the SMMOA Focus Area Team
  - **Open Sensors/Networks Interface (OSNI) Development**
  - **Open Material Condition Information (OMCI) Development**
  - **Open Logistics Support Interface (OLSI) Development**
- OSNI has been active for 2 1/2 years
- OMCI has been active for 1 1/2 years
- OLSI has just started

SMMOA Vision

Fleet Support

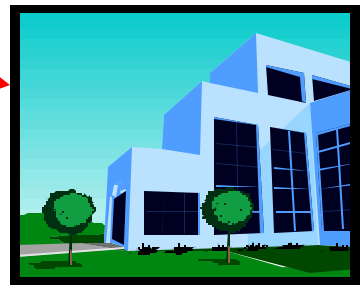
ISEAs / FTSCs

Supply

Tech Data Library

Config Data Mgr

Personnel



SUPPLY

CM

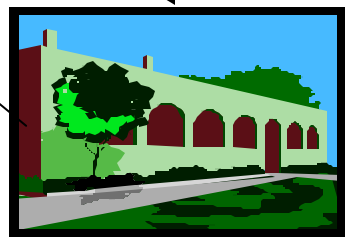
Personnel

Maintenance

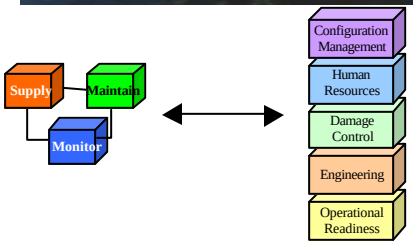
Monitored Data

JIT Parts
Maintenance Assist
CBM
Accurate CM Data
Tech Infusion
Tech Data Update
Training Assist

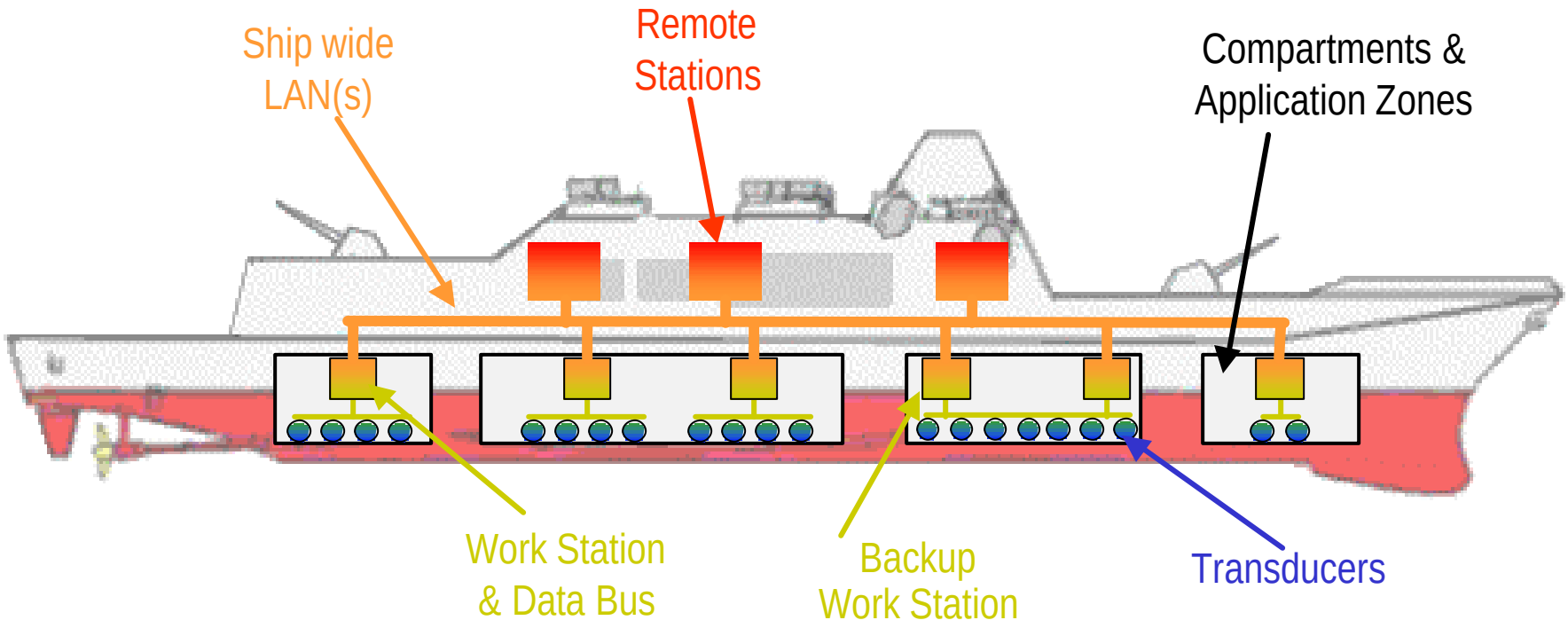
Benefits of open information exchange



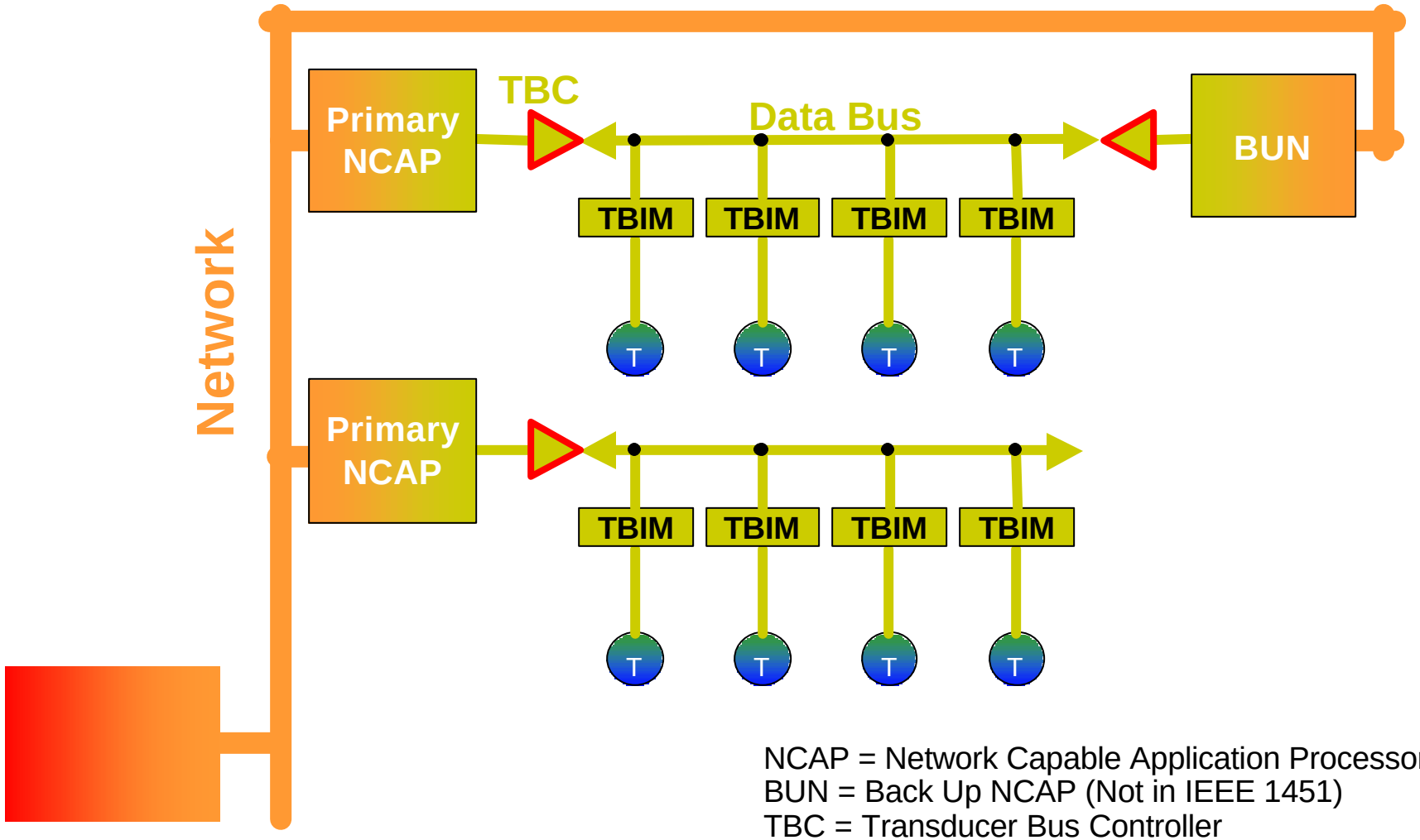
Vendors



Open Sensors & Networks

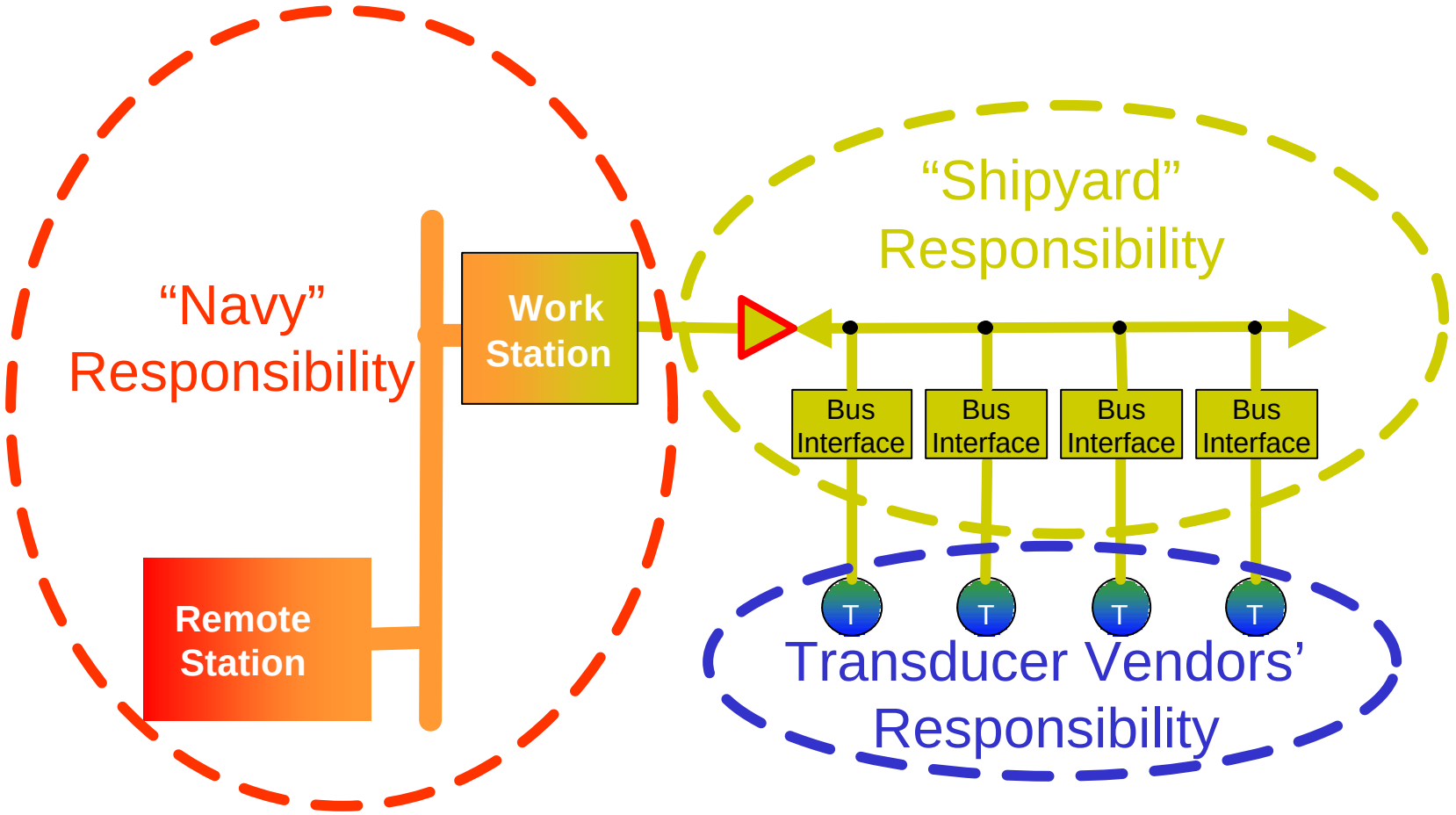


IEEE 1451 Architecture



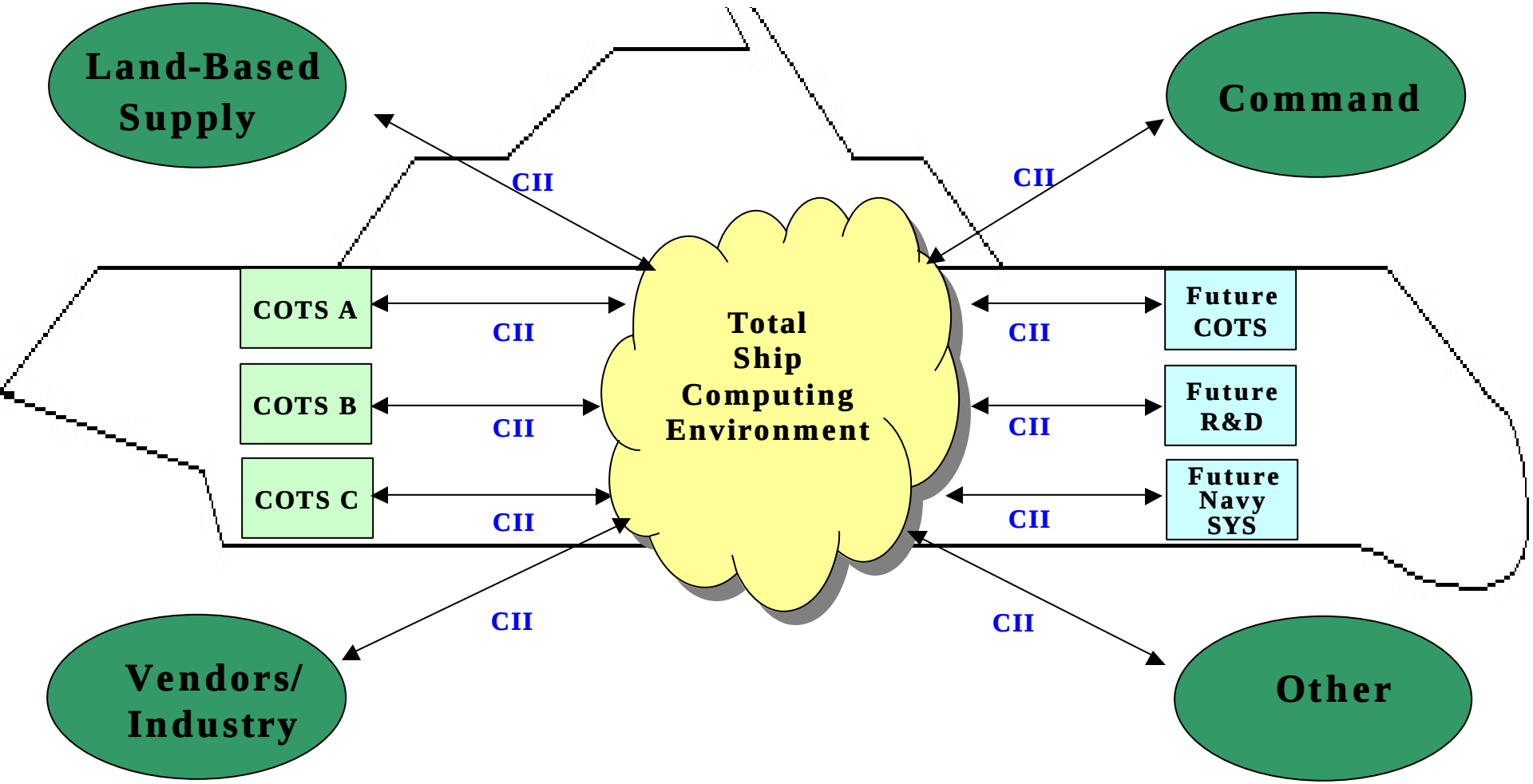
NCAP = Network Capable Application Processor
BUN = Back Up NCAP (Not in IEEE 1451)
TBC = Transducer Bus Controller
TBIM = Transducer Bus Interface Module
T = Smart Transducer

Standardization Responsibilities

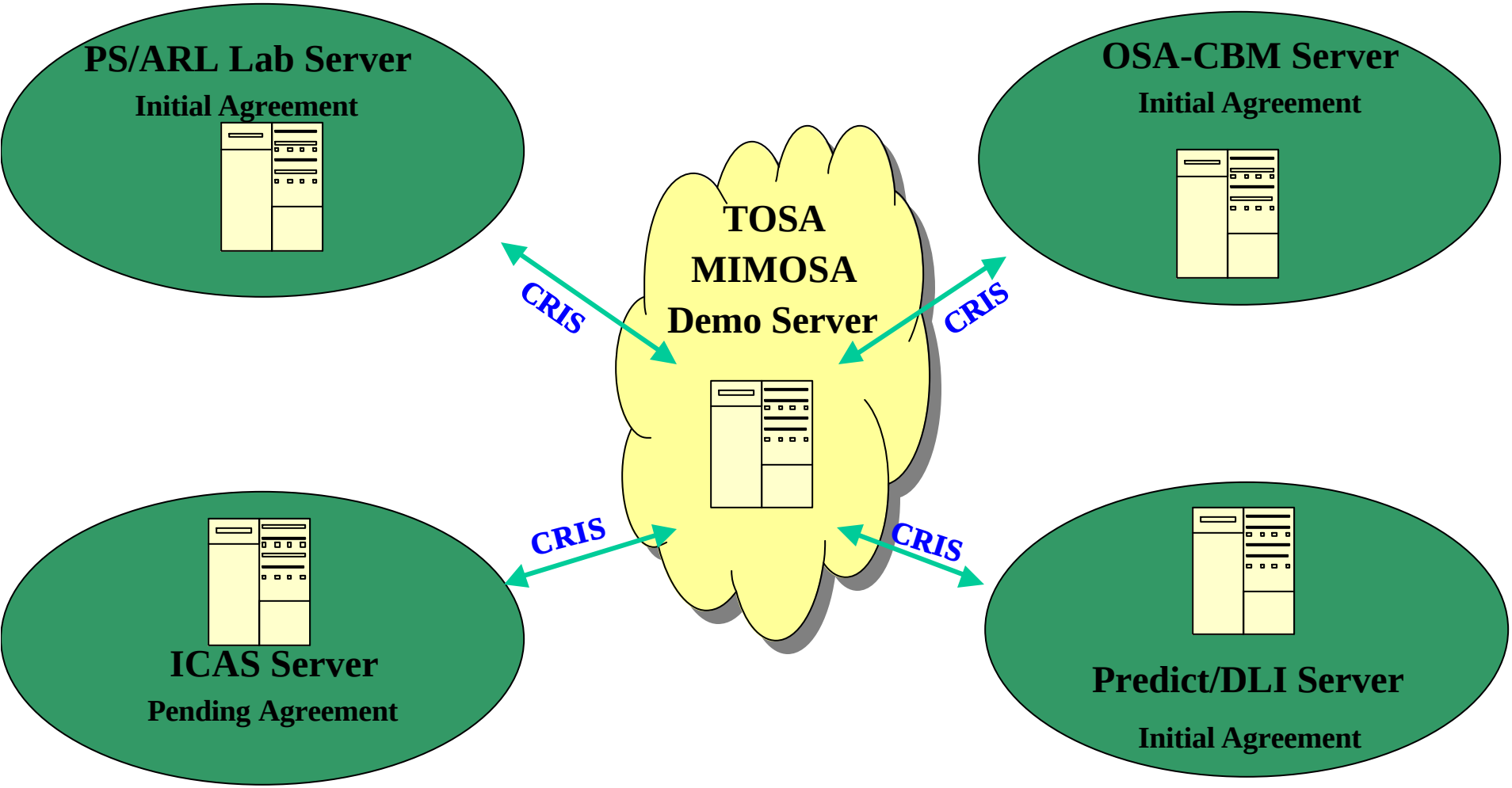


Vision: Open Material Condition Information (OMCI)

An open, common information interface (CII) for all material condition information.



TOSA OMCI Server Demonstrator



Goal: Demonstrate Information Interoperability